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ABSTRACT

Drawing from Tallahassee Community College's (TCC's) experiences with energy conservation, this paper offers suggestions for reducing energy costs through computer-controlled systems and other means. After stating the energy problems caused by TCC's multi-zone heating and cooling system, the paper discusses the five-step process by which TCC obtained a State Energy Grant. One of these steps, the preparation of an Energy Audit Report, is described in detail, and the energy problems revealed during the preparation of this report are reviewed. Specifically, the paper looks at the following: TCC's response to federally mandated maximum and minimum settings for room thermostats; the effects of turning off lights, air handling units, and water heaters when not in use; and how the savings in capital outlay funds were offset by physical plant problems. Next, the paper explains how utility company energy consumption charts were used by TCC to identify and minimize peak demand times. The benefits of the computer-controlled system are then enumerated: for example, it freed TCC's physical plant crew to return to maintenance tasks; it reduced the peak energy consumption periods to a minimum; and through the use of line capacitors, it increased the energy efficiency of the college. A checklist of non-computer-related energy conservation activities is followed by a discussion of the possible benefits of cogeneration of energy via a coal-fired furnace. Energy charts are appended. (AYC)

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ENERGY -- WHAT TO DO UNTIL THE COMPUTER COMES

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ENERGY - WHAT TO DO UNTIL THE COMPUTER COMES

So you have read how to save energy with a computer, and you may have put one on order -- now what to do until the computer comes?

Tallahassee (Florida) Community College started in 1966 when energy conservation was a problem for physics students, and gasoline was 39¢ a gallon. Now energy is a department in the federal government, and gasoline is who-knows-what per gallon.

Our college installed a multi-zone heating and cooling system which was then commonly in use, reasonable in price, comparatively simple to maintain and fairly effective for our north Florida climate, but very energy wasteful. Air was brought into the system, then heated and cooled simultaneously to the desired temperature. As a result, the heaters and coolers ran all of the time, seven days per week, as we thought that it took more energy when a light was turned on and off than it did to run all the time. Oh, the barrels of oil we wasted for several years!!

Three years ago, when the Arabs folded their tents in the night and opened their condominiums in the daytime, we took stock and went to work on the problem. Our maintenance force, despite the shortage of personnel, is really quite good, and the supervisor, Mr. Thomas Lewis, is a man who grew up with our system. He learned that our Governor, Mr. Bob Graham, was willing to put dollars into a search for energy saving systems, so we made an application for a State Energy Grant.

There are five basic steps to obtain an Energy Grant:

1. Preliminary energy audit
2. Energy Audit Report - a technical audit by a certified engineer
3. Application for an Energy Conservation Measures Grant
4. Receipt of notice of approval for Grant
5. Receipt of notice of Grant award which is followed by advertising for bids and award of the contract

The preliminary energy audit comes under the auspices of the National Energy Act which awards grant programs for schools and hospitals, buildings owned by units of local government and public care institutions. In Florida, these grants are administered through a special division located in the Office of the Governor, which gives one an idea of the importance of energy to Florida. The preliminary energy audit is in

questionnaire form. We treated our entire plant as a single building for the purposes of this audit, so don't be startled when you see the size of the building as being 314,200 square feet, which would probably be acceptable in Washington, D.C., but not in Tallahassee, Florida.

The questionnaire elicits information about the type of heating systems, air handling systems, building construction, and then goes into a series of questions related to the cost of electricity, natural gas, distillate, residual fuel oils, coal, and so forth. Finally, it asks for the demand rate of electricity for the past year.

In step two, an energy audit report must be conducted by a certified energy auditor. We did not have available a certified engineer, so Mr. Lewis went off to school, and, after completing a rather stringent course, became certified as an energy auditor; consequently, our audit report was factual since he knew where all of the skeletons were hidden. In this report, the use of energy is questioned in great detail, and a full series of forms must be processed to determine the energy usage of BTU.

A second portion of the report covers a series of steps which, if taken, should result in a considerable energy savings. We found this to be quite true, and our savings were so much that they almost discouraged us from continuing further efforts to purchase a computer. However, certain other factors which we will cover later with regard to personnel utilization overshadowed the dollar expenditure.

A third section of this report is concerned with energy measures which were suggested for further study. As an item of external shading, we had planted some fast growing trees to shade the south side of the building where possible. As other existing trees seemed to be of considerable help, we really did this, even though the first set of trees we planted died,and we had to replant all over again. We did not include the cost of tree planting in our energy study! !

We received the notice of approval of our energy conservation measures grant that was the fourth step, followed by the notice of grant award at which time we went through the normal advertising for bids and awarded the contract. The computer system's total cost was $251,396 and was on a 50/50 match, so it cost us $125,698.

So much for the actual mechanics of getting the grant and the computer. If you want a copy of our grant requests, let me know, and you might be able to use them as a "cookbook" to submit your own requests. Get me your name and address, and I'll send you everything we have.

These steps, although they were expensive and necessary, were not the elements that interested me most about our energy conservation matters. It was during the Energy Audit Report when we began to see ways that we could effect a considerable savings that I became interested, and I'd like to briefly touch upon some of those measures at this time.

The President of the United States had mandated maximum and minimum settings for room thermostats which, in other than certain exempted areas, required a setting of 78° in the summer and 65° in the winter. (I recall years ago when I was in the Army, and we lived with Truman's temperature of 72° rain or shine!!) As is often the case, federal guidelines which established the 65° and 78° temperatures were written in Washington's

bureaucratic language. Our maintenance personnel who were responsible for their implementation couldn't read the specification -- nor could I.

For fall, we set at 65° and lived with a few complaints until it warmed up about 10 A.M., which required manual setting of room thermostats and cutting off all air conditioning equipment in winter and heaters in summer. Thus we ran our system, not as designed, but more efficiently.

We began our experimental work on trying to live with temperatures warmer than normal during the summer term when there were fewer faculty and students on the campus to complain about the room temperatures. This may not have been very scientific, but it was a practical means of self-preservation.

We began by encouraging everyone from the President up or down (depending upon your frame of view) to turn off lights at any time they left a room. We replaced most of our incandescent lamps with flourescent lights and then removed one half of the bulbs from most flourescent lights. (When you remove the bulbs, be sure to remove the balast also -- otherwise you won't really be saving as much energy.) Next we began by shutting off all air-handling units whenever there was no one in that zone of the campus. The water heaters were shut off by time clocks in the physical education building at the end of the day and not reheated until almost noon the following day. Even though the early exercisers had to take cold showers, I think this was a considerable savings since water heating requires a tremendous outlay of energy.

Even on our small campus, we found our maintenance crew spending an inordinate amount of time responding to calls from faculty members to "come quickly and cool down my room," and to be at several locations at various times to make sure air-handling equipment was shut off or on. This was almost a one-man full time job. As a result, we began to see a considerable savings in capital outlay funds, but our physical plant began to take a beating. Maintenance personnel could not be shutting off electrical switches and making building repairs, patching, painting, or replacing defective water faucets at the same time. However, since our buildings were new and in good condition and had been meticulously maintained, we were able to slight maintenance for several years, but ghosts have a way of coming back to haunt you.

Is there a particular time of day when your energy expenditure is higher than normal, and if so, how can it be determined? Your utility company probably uses a system similar to that used in Tallahassee. Each month we are billed by the City of Tallahassee for our electrical energy consumption. (They also include water and gas, but I'm limiting this discussion to electricity as that is a universal commodity.) As one might suppose, there is a charge for the total number of kilowatt hours used, but there is also an additional separate charge designated as a demand charge. Slide 1 is a copy of the Demand Chart for August 1977 when we began our energy study. Each thirty minutes throughout the day and for each day of the month, the meter records the amount of power being used at that time. At the end of the month, the total energy cost is based upon this thirty minute peak demand. Not only is the month based upon that figure, but the monthly demand chart cannot be less that 75% of the highest demand period over the past year. Kipling said, "The evils we do two by two, we pay for one by one," but we have found that the highest energy expenditure we do in one thirty minute period, we pay for month by month. It behooves us to reduce this peak to a minimum.

On the chart you will note readings at thirty minute intervals over a thirty-one or thirty-two day period as they are not always prompt in changing the charts. The August 1977 peak occurred on the 5th at 1 P.M. with a reading of 70. When that figure is then multiplied by a constant of 16.20, it develops a charge of 1134 KW demand, but the actual charge was computed on a earlier month which had 1296 KW and was $2,306.88, instead of $2, 018.52.

How effective were our energy measures? The next charts show comparisons of the same months in 1977 and 1980. What is not visable are the two rather large buildings we added in 1979 and 1980. We also lost some buildings when we separated from an adjoining school, but the increase was more than the loss. One of the new buildings is a 504 seat theatre with a cafeteria, bookstore, and several offices, while the other is an additional two stories on the library.

An interesting sidelight occurred when Mr. Lewis noticed that every Saturday there was a power surge at midnight for no apparent reason. Upon investigation, he found a newly employed part-time security guard had turned on the air conditioner whenever he came on duty to cool down his office and, incidentally, the entire administration building. He saw the error of his ways.

Now for energy saving methods: one reason we are spending $250,000 to install a computer-controlled system is to permit our maintenance crews to return to their proper duties. A human can do almost everything a computer can, but not as efficiently, nor can they do their regular job at the same time. Skimping on maintenance is just putting off trouble to another day. It was all right for Scarlett to say, "I'll worry about that tomorrow," but it's poor practice for an institution.

We will set the computer at an established demand load to reduce the peak period to a minimum. When the computer senses it is approaching the maximum power setting, it will begin turning off electrical equipment on an established priority for specified periods of time -- say, five minutes out of the half hour. A room won't have time to change temperature noticeably, and the current will return soon enough to pick up the slack. However, the high peak load will have been avoided.

One of the most efficient energy saving devices is the installation of line capacitors. A capacitor cuts down on line loss of keeping motors, et al, in phase so that the energy is better channeled in the same direction. When the electrical current passes through a wire to run some motor, part of the energy is used just getting along the wire, and a capacitor will help reduce this line loss to an acceptable minimum, generally about 7%. Although these capacitors are fairly expensive to install, they should pay for themselves in less than a year. Ours paid out in about seven months, and we were saving money from then on.

There are many uses for a computer besides heat and cooling control. Sensor devices may be added which will notify campus security of unauthorized entry into restricted areas, scheduled turn on and turn off times for campus lighting, even turn on and off your morning coffee pot if your secretary objects to such labor -- all under the control of the same micro-computer.

A partial checklist of actions to take while waiting for your computer is as follows:

1. Cut off hot water heaters before physical education classes end and do

not restart heaters until after class begins the following day.

2. Cut off lights when you leave a room -- soon becomes a good habit everywhere.
3. Plant trees and shrubbery to break sunlight on southern exposure walls.
4. Remove bulbs and balasts from flourescent lights where overlight exists. Our light meters indicated nearly every room was almost twice as brightly lighted as needed by occupants.
5. Schedule summer classes in fewer buildings.
6. Add capacitors to your electrical system as needed.
7. Raise chill water temperature whenever and wherever possible. The local estimated savings is 4% per degree raised. (Example: five degrees warmer provides a 20% energy saving on that particular piece of equipment.)
8. Lower hot water temperatures to the degree needed, not necessarily the degree desired.
9. Do not run heat and cold at the same time, even if your system was so designated.
10. Learn to live with complaints!!

Although dollar savings may be paramount in your plans, we most observe the big picture of energy consumption. Suppose you had an energy limit placed on your institution -- do you have a written contingency plan which spells out in logical phases how you will continue operation, where you will combine functions, and which ones will be suspended, et cetera? I rather doubt that you do; I know we don't. It is yet another of those tomorrow's worries, but one worth considering.

Everywhere you look these days there are energy publications. The week I began work on this talk, I received two rather interesting publications on the subject. One is School Product News (June 1981) which has a feature on "The Search for Energy." Passive or active solar plants are installed at 116 educational installations in 37 states. Federal dollars are available for these projects.

Cogeneration is a lost art which is returning. In 1910, more than 60% of all electrical power generated in the United States came from such systems. That had dropped to 5% by 1973 as public utilities became more available and cheaper. However, now the price of fuel oil has skyrocketed, cogeneration again looks promising. Essentially a coal-fired furnace heats water to produce high pressure steam which turns a turbine to power an electrical generator to produce electricity, and the used steam is then piped to heat water and/or the facility.

Iowa State University has been doing this for about 100 years. The University of Texas at Austin in 1979 produced 2.26 million KW of electricity. When the University of Minnesota completes its cogeneration facility, it will produce enough steam heat for 200 buildings on an eleven million square feet campus and also supply steam to Augsburg College and to two nearby hospitals at rates favorable to the college.

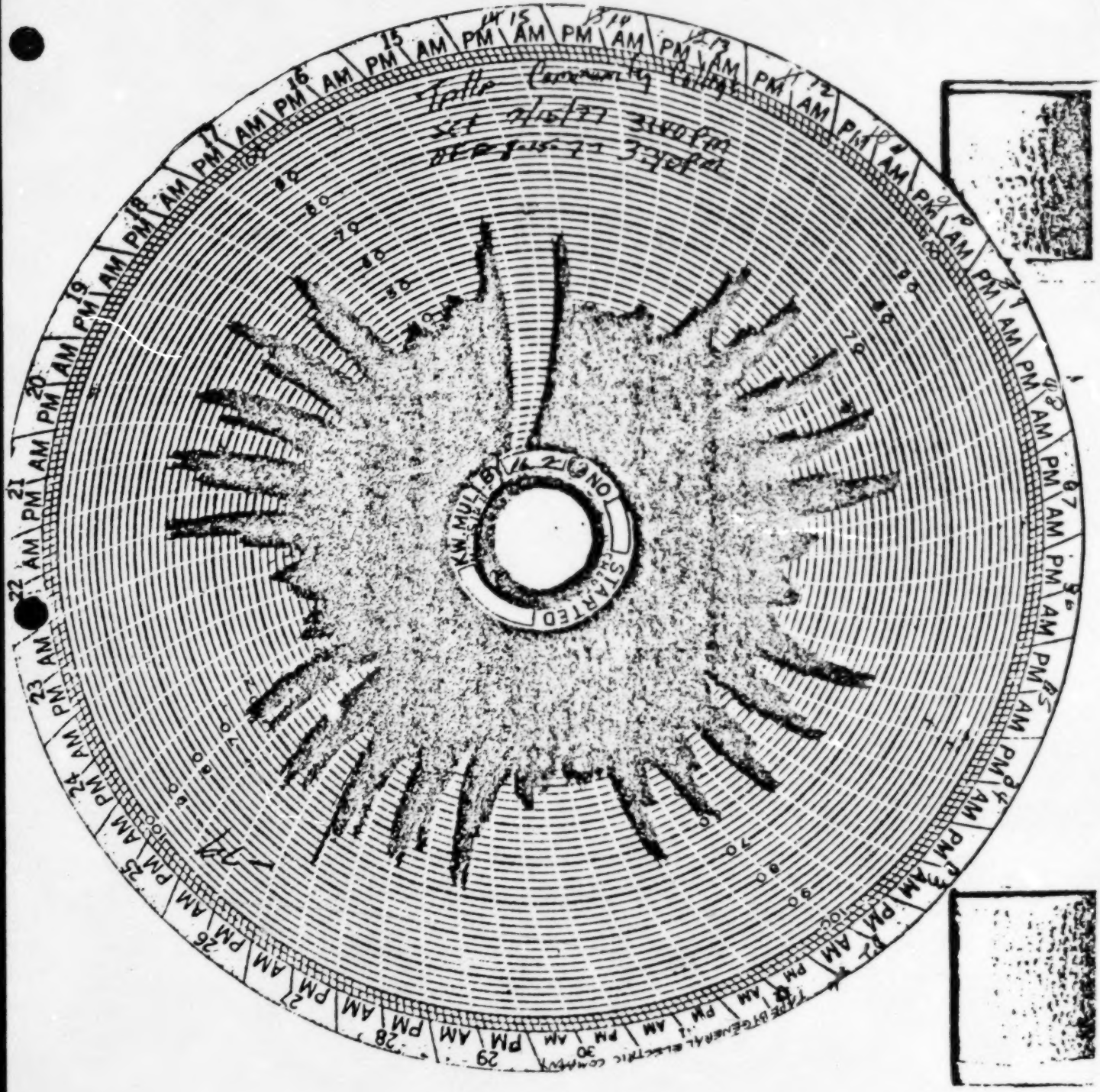
There is a publication "Cogeneration: A Campus Option?" which outlines all of the steps involved in making the decision to cogenerate. I'd suggest that you get a copy of School Product News and read the rather brief but informative article from which I have abstracted these remarks on cogeneration.

I don't know if I fit the bill since I came here at someone's invitation, but there is a lot of sense in what the Department of Energy's Mr. Stephen says, "There are a lot of snake oil salesmen going around selling audits ... but audits are not enough. An audit might recommend that a school turn off lights, shut down boilers, and cut back on activities, (Sounds familiar -- wish I'd read him before I wrote this paper!!) but the real problem is that we built a nation of energy inefficient schools in the 1950's and 1960's. Audits won't change the boilers or the thermal resistivity of the roof, walls, and glass."

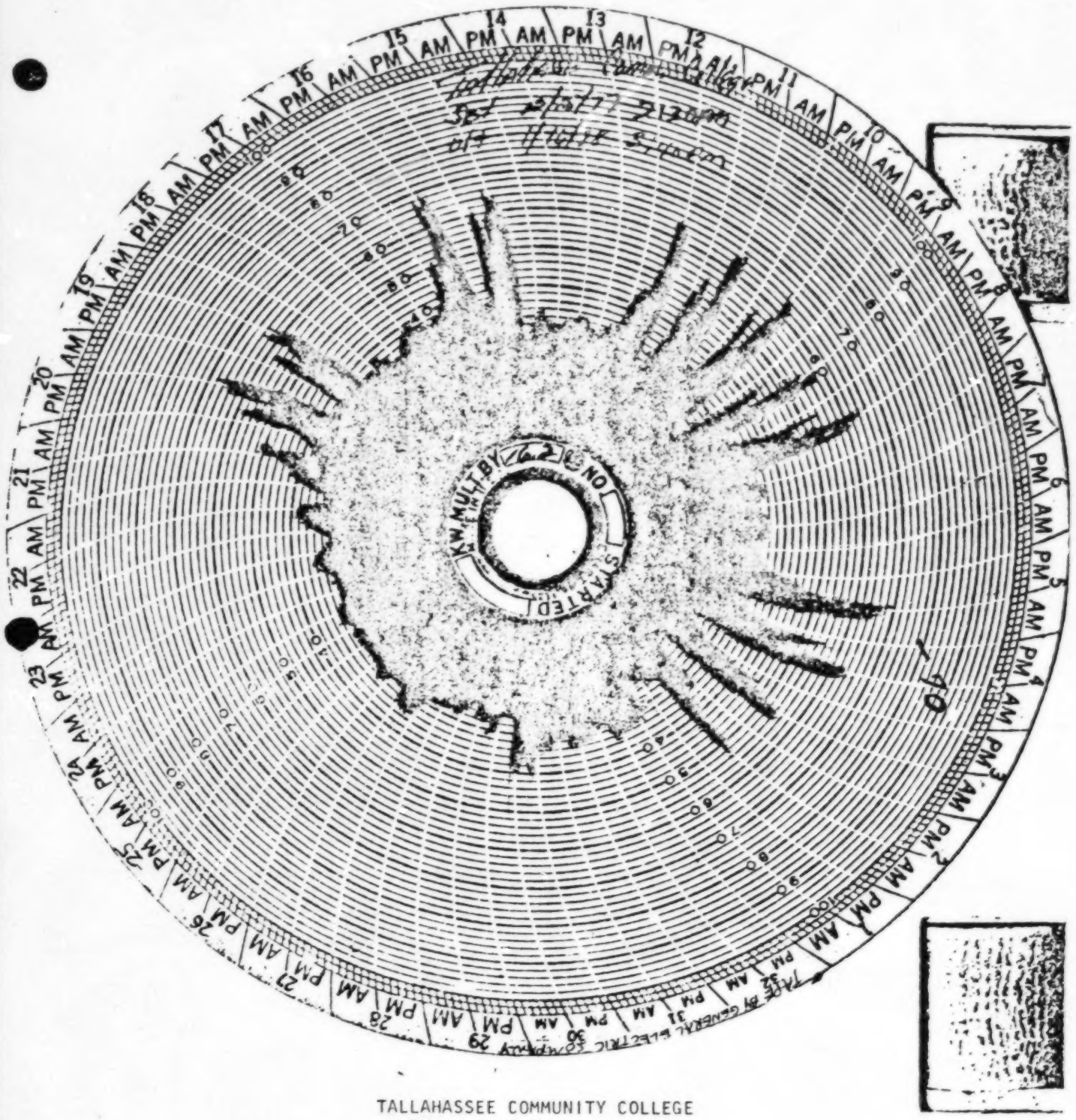
It might be well to conclude with another remark from Stephen: "Administrators shouldn't be afraid to purchase technology that will help them use energy efficiently."

Let me know if there is any way in which we at Tallahassee Community College may be of assistance to you, and if you want any of these references, get your name and address to me, and I'll do the rest.

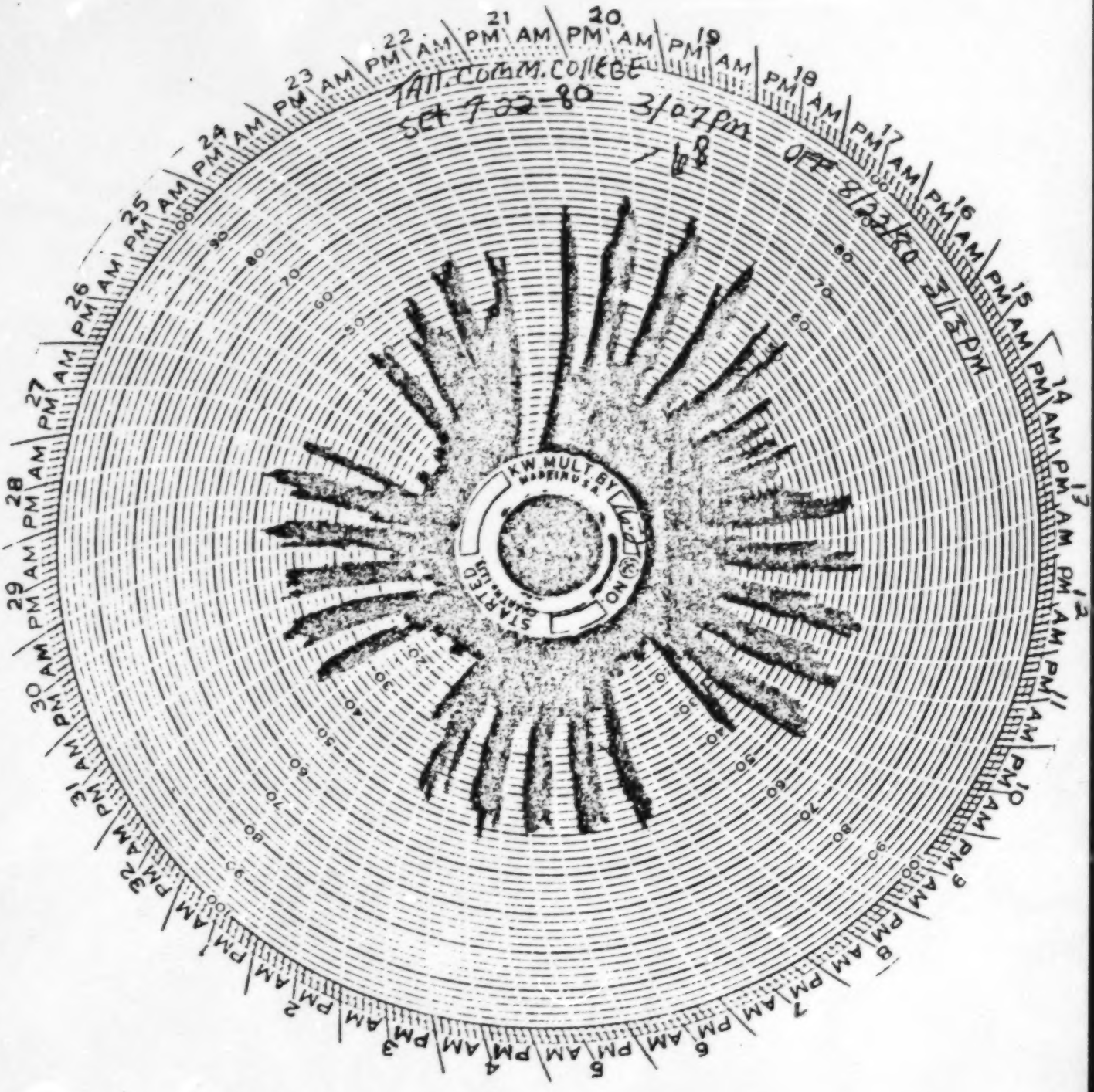
Archie B. Johnston, Ph.D.
Director of Systems and Research
July 15, 1981



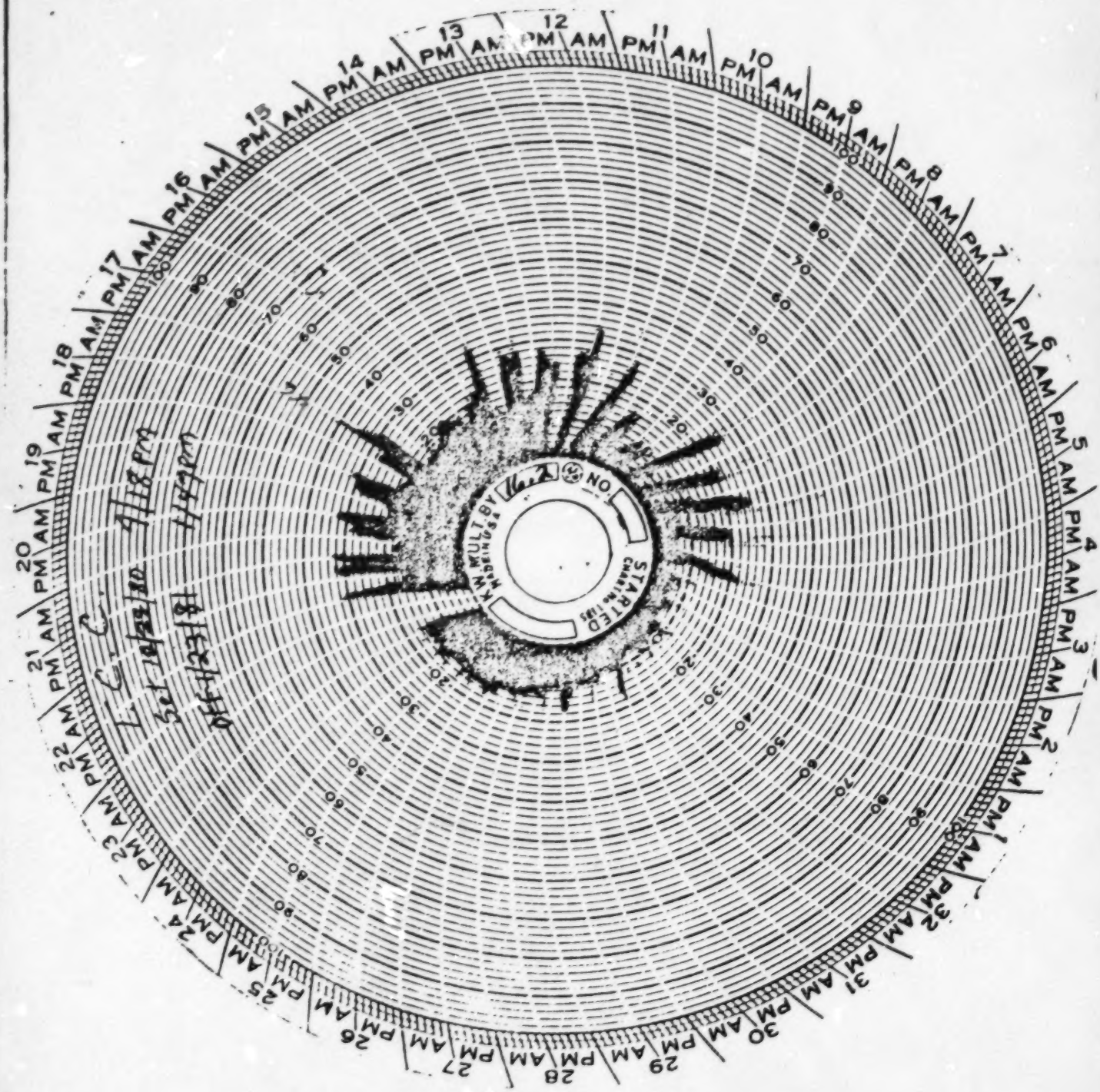
TALLAHASSEE COMMUNITY COLLEGE
Electrical Power Demand
July - August 1977



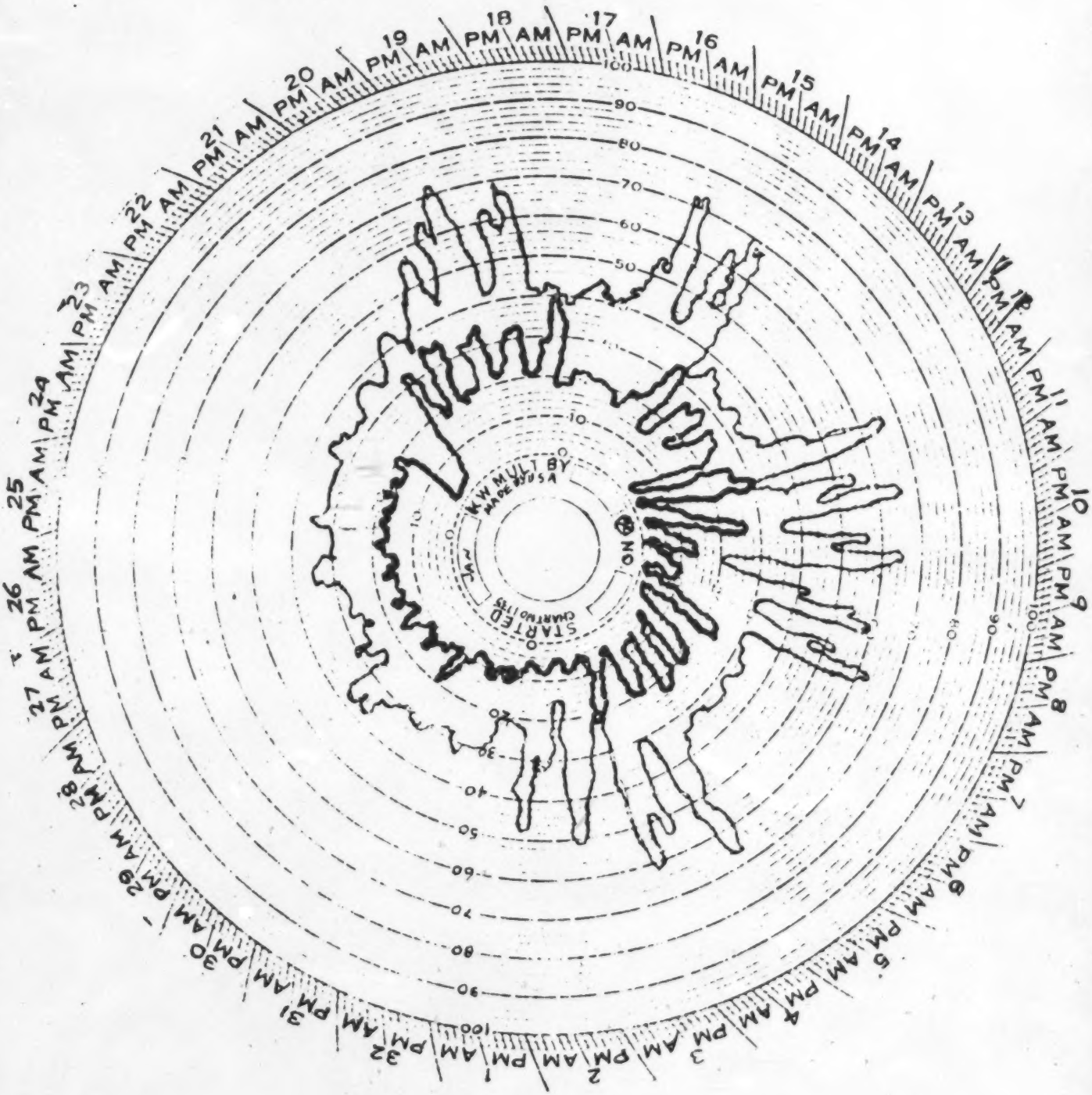
TALLAHASSEE COMMUNITY COLLEGE
Electrical Power Demand
December 1977 - January 1978



TALLAHASSEE COMMUNITY COLLEGE
Electrical Power Demand
July - August 1980



TALLAHASSEE COMMUNITY COLLEGE
Electrical Power Demand
December 1980 - January 1981



TALLAHASSEE COMMUNITY COLLEGE
Electrical Power Demand
Comparison Showing Savings
Dec 77 - Jan 78 vs Dec 80 - Jan 81

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